MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

PCM0016 – CHEMISTRY

(All sections / Groups)

2 MARCH 2020
2.30 p.m – 4.30 p.m
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of 4 pages only excluding the cover page.
2. Attempt **ALL** questions. Distribution of the marks for each question is given.
3. Please write all your answers in the answer booklet provided.

QUESTION 1 [20 MARKS]

(a) Given the equation below. Answer the following questions.

$$CoCl_2 \cdot 6H_2O \xrightarrow{Reaction\ X} CoCl_2$$

(i) Give the name of the reactant and product. [1.5 marks]
(ii) Suggest what *Reaction X* is. [1 mark]

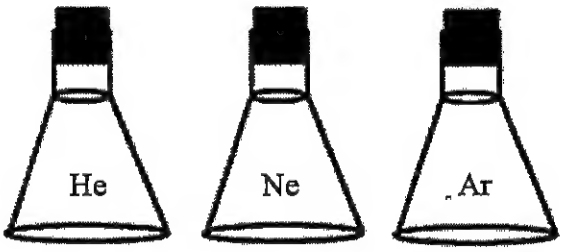
(b) 55 g of C_2H_2 is allowed to react with 86 g of hydrochloric acid to produce vinyl chloride, C_2H_3Cl. [Atomic mass: H = 1.0; C = 12.0; Cl = 35.5]

(i) Write a balanced chemical equation for the reaction. [1 mark]
(ii) Identify the limiting reactant. [2 marks]
(iii) Calculate the mass of the excess reactant left at t = final. [1 mark]

(c) If element M composes of two isotopes: ^{25}M and ^{26}M, and the relative atomic mass of M is 25.3, find the percentage abundance of each isotope. [1.5 marks]

(d) At STP, a 30.26 g of a gas occupies 21.2 L. Find the molecular weight of the gas and predict the gas (with diatomic molecule).
[The universal gas constant, R = 0.08206 L.atm/mol.K] [2 marks]

(e) Figure shows three 2.0 L flasks, each at a pressure of 800 mmHg, contain He, Ne, and Ar.



(i) Which flask contains the most atoms of gas? Briefly explain. [1 mark]
(ii) If the He flask was heated and the Ar flask was cooled, determine which of the three flasks would be at the highest pressure. Explain briefly. [1 mark]

(f) The standard enthalpy of formation of one mole of ethanol is −278 kJ. If the density of ethanol is 0.789 g/mL, calculate the heat energy released when 0.25 L of ethanol is formed. [Atomic mass: C = 12.0; H = 1.0; O = 16.0] [2 marks]

Continued...

(g) Determine ΔH_f^o for the formation of chlorine trifluoride:

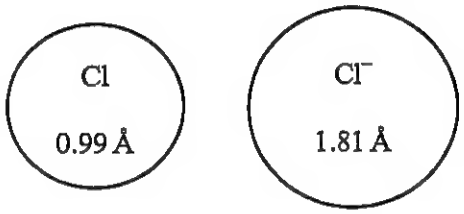
$$ClF\,(g) + F_2\,(g) \rightarrow ClF_3\,(g) \qquad \Delta H_f^o = ?$$

Given:

	Equations	ΔH_{rxn}^o (kJ)
a.	$2\,OF_2\,(g) \rightarrow O_2\,(g) + 2\,F_2\,(g)$	−49.4
b.	$2\,ClF\,(g) + O_2\,(g) \rightarrow Cl_2O\,(g) + OF_2\,(g)$	+205.6
c.	$2\,ClF_3\,(g) + 2\,O_2\,(g) \rightarrow Cl_2O\,(g) + 3\,OF_2\,(g)$	+266.7

[3 marks]

(h) The atomic and ionic radii of chlorine atom and chlorine ion are given below. Explain why the values are different.



[2 marks]

(i) State the group and period of an element that has maximum $3p^2$ electron arrangement. [1 mark]

QUESTION 2 [15 MARKS]

(a) Given the set of quantum numbers for electrons in the orbital with highest energy for atom *A* are (3, 2, 0, +½), (3, 2, 1, +½) and (3, 2, -1, +½).

(i) Name the orbital of the electrons. [0.5 mark]
(ii) Draw the electronic configuration of atom *A*. [1.5 marks]
(iii) If five electrons were removed form atom *A*, state the number of unpaired electrons. [0.5 mark]

(b) (i) Draw the molecular geometry for I_3^-. [1.5 marks]
(ii) How many lone pairs are there in I_3^- molecule? [0.5 mark]
(iii) State the molecular geometry for I_3^- molecule. [0.5 mark]

(c) The reaction below has a rate constant of $6.2 \times 10^{-5}\ s^{-1}$ at 35 °C. Suppose that the initial concentration of $C_{12}H_{22}O_{11}$ in the solution is 0.40 M.

$$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6\,(\text{glucose}) + C_6H_{12}O_6\,(\text{fructose})$$

Continued...

(i) What will the $C_{12}H_{22}O_{11}$ concentration be after 120 minutes? [1.5 marks]
(ii) How long will it take for $[C_{12}H_{22}O_{11}]$ to drop to 0.30 M? [1 mark]

(d) The following are covalent molecules of different polarity. Determine if they are polar or non-polar and state the type of intermolecular forces between the molecules.

Molecule	Polarity	Intermolecular forces
(i) NH_3		
(ii) Methane		

[2 marks]

(e) Draw the orbital overlap of the hybridization of C_2H_4 (label all the bonds). [2.5 marks]

(f) Derive an expression to show the relationship between K_c and K_p for the following gaseous reaction:

$$aA(g) + bB(g) \rightleftharpoons cC(g) + dD(g)$$ [3 marks]

QUESTION 3 [15 MARKS]

(a) Referring to the reaction below:

$$2H_2(g) + O_2(g) \rightleftharpoons 2H_2O(g)$$

(i) Predict what will happen to the concentration of H_2O if some amount of O_2 is added to the system. [0.5 mark]
(ii) Predict the effect on the equilibrium system if a catalyst is added. [0.5 mark]

(b) For the table below, answer (i), (ii), (iii), (iv), (v) and (vi).

Solution	pH	$[H^+]$	pOH	$[OH^-]$	Acidic, basic or neutral?
x	(i)	(ii)	9.8	-	(iii)
y	-	(iv)	(v)	4.3×10^{-7}	(vi)

[3 marks]

(c) Calculate the pOH of each of the following solutions.
[Atomic mass: Co = 59.0; H = 1.0; O = 16.0; C = 12.0]

(i) A cobalt (II) hydroxide solution made from 7.06×10^{-3} g cobalt (II) hydroxide and enough water to make 2.0 L of solution. [1.5 marks]
(ii) 0.15 M CH_3COOH solution at 25 °C (K_a for $CH_3COOH = 1.8 \times 10^{-5}$) [2 marks]

Continued...

(d) Determine the oxidising and reducing agents for the redox reaction:

$$Zn\,(s) + Cu^{2+} \rightarrow Zn^{2+} + Cu$$ [2 marks]

(e) Determine the oxidation number of the underlined elements in the following ions:

$\underline{S}O_4^{2-}$	$H\underline{C}O_3^-$	$\underline{Mn}O_4^{2-}$
(i)	(ii)	(iii)

[1.5 marks]

(f) Arrange the following species in order of increasing oxidizing strength and reducing strength:

$Zn^{2+} + 2e^- \rightarrow Zn$	$E^\ominus = -0.76$ V
$I_2 + 2e^- \rightarrow 2I^-$	$E^\ominus = +0.54$ V
$VO_2^+ + 2H^+ + e^- \rightarrow VO^{2+} + H_2O$	$E^\ominus = +1.00$ V
$Fe^{3+} + e^- \rightarrow Fe^{2+}$	$E^\ominus = +0.77$ V

[2 marks]

(g) Calculate the mass of copper deposited at the cathode if a current of 0.135 A flows through aqueous copper (II) sulfate for 30 minutes.
[Atomic mass: Copper = 63.5; Faraday constant = 96500 C/mol e^-] [2 marks]

End of Paper